U.S. ARMY ANTHROPOMETRIC SURVEY (ANSUR II)

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US ARMY RDECOM

US ARMY NATICK SOLDIER RD&E CENTER

ANSUR II

Purpose:

Anthropometric Models to Optimize the Human Systems Interface (ANSUR II)

- To develop new anthropometric models for Soldier and aviator clothing and equipment design, develop anthropometric specifications for digital human figure models to be used in workspace and workstation design, and support CIE fielding requirements, all through an update of the 1988 ANSUR database providing the first ever comprehensive 2D / 3D anthropometric database that includes Active Duty, National Guard and Reserve components.

Timeframe: October 2009 – January 2014

EVERYTHING a Warfighter wears, carries, flies, drives, rides in, works in and sleeps in depends on anthropometry …

Anthropometry Impacts the Sizing & Design of …

- Clothing & Individual Equipment
- Load Carriage & Body Armor Systems
- Workspaces & Workstations
- Aircraft & Ground Vehicles
- Human Digital Models for Design & Evaluation

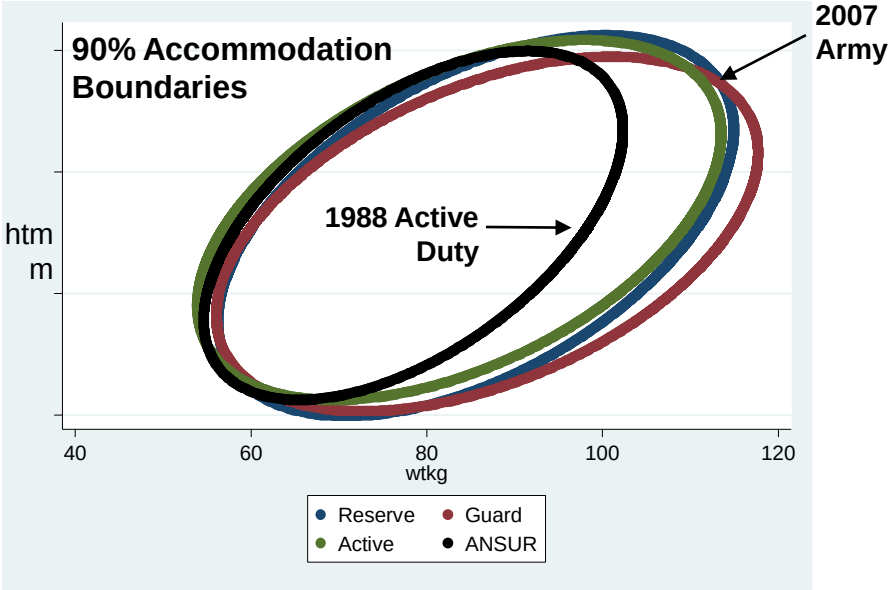
Anthropometric Change: 1988-2007

Pilot Study for ANSUR II Survey:

Ft. McCoy & Ft. Hood

Males: 1475 Active, 771 Reserve, 565 Guard

Female sample sizes much smaller, but results similar to male



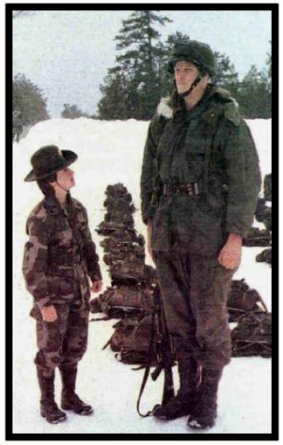
Active Duty Males	1988	2007	Delta
Height (in)	69.1	69.3	0.2
Weight (lbs)	172.7	184.1	11.4*
Crotch Ht (in)	33.0	32.9	0.0
Chest Girth	39.0	40.8	1.8*
Waist Girth	34.0	36.3	2.3*
Hip Girth	38.7	40.3	1.6*

** statistically significant difference, $p < .001$*

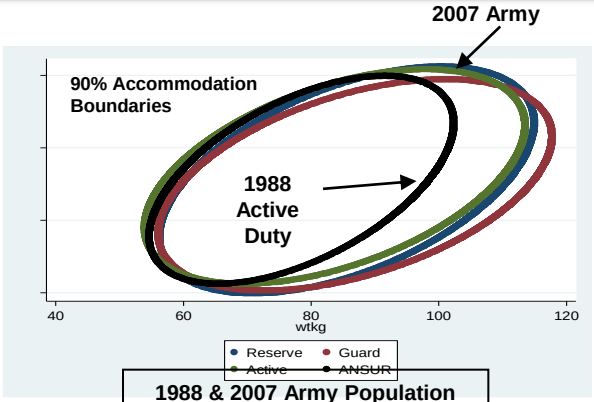
Conclusions:

- Army body sizes outside range of 1988 database & cannot be modeled
- Need to update database *ASAP*
- Body size differences among Army components small relative to change in Active Duty since 1988

Anthropometric Models to Optimize the Human Systems Interface (HSI)



Anthropometry for all Soldiers



1988 & 2007 Army Population Accommodation Boundaries

Purpose:

Develop new anthropometric models for Soldier and aviator clothing and equipment design and develop anthropometric specifications for digital human figure models to be used in workspace and workstation design

Results:

- Statistically optimized models for Total Army sizing of combat clothing and individual equipment
- Statistically optimized families of 3D digital human models for computer aided design of aircraft, ground vehicles, & workstations
- Updated tariffs to decrease acquisition & resupply costs
- Updated data on Active Duty; first ever anthropometric data on Reserve & Guard; first integrated database with 2D direct measurements and 3D scan images on the same subjects

Milestone Schedule	FY09	FY10	FY11	FY12	FY13	FY14
Phase I: Plan & Fund Program						
Phase II: Research Design						
Phase III: Data Collection						
Phase IV: Data Base Deliverables						
Summary Statistics						
Tariffs						
Phase V: Model Development						
Accommodation Boundaries						
Digital Human Models						
Clothing/Equipment Models						

Payoff:

- Statistically valid digital human models for cost saving, efficient design, sizing and tariffing in support of OCO
- Improved operational readiness by integrating Guard & Reserve fit/sizing requirements throughout materiel life cycle
- Reduced risk of human factors failures in acquisitions and innovative exploratory development

Transition:

- Sizing models transition to CIE developers, PMs, and their contractors to provide a common anthropometric foundation for Army sizing systems
- Families of digital human models transition to aircraft & ground vehicle developers, PMs and their contractors to provide a common anthropometric basis for Army crew stations
- Statistical summaries transition to requirements developers for establishing anthropometric accommodation requirements

ANSUR II: Anthropometric Models to Optimize the Human Systems Interface

Database Objectives

- Update ANSUR active duty database
  - ✓same statistical precision
  - ✓same minority group sampling
- Add Guard database
- Add 3D scans: head, foot & body

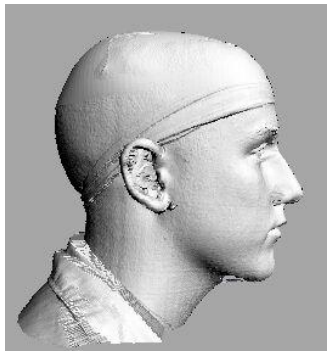
Modeling Objectives

- Summary statistics, accommodation requirements & CIE tariffs
- Statistically optimized models for sizing combat clothing and equipment
- Statistically optimized families of 3D digital human models for Computer Aided Design of aircraft, ground vehicles, & workstations

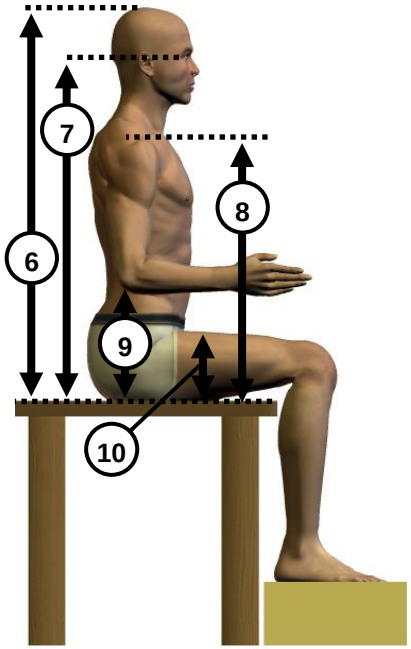
ANSUR II Database

Demographic Data

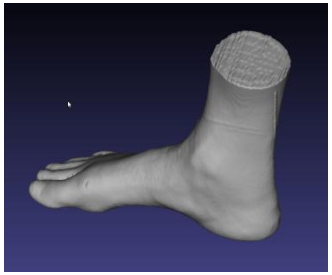
- age, sex, birthplace
- racial/ethnic groups
- component, rank, PMOS, unit
- last deployment
- next scheduled deployment
- self-reported height & weight
- handedness

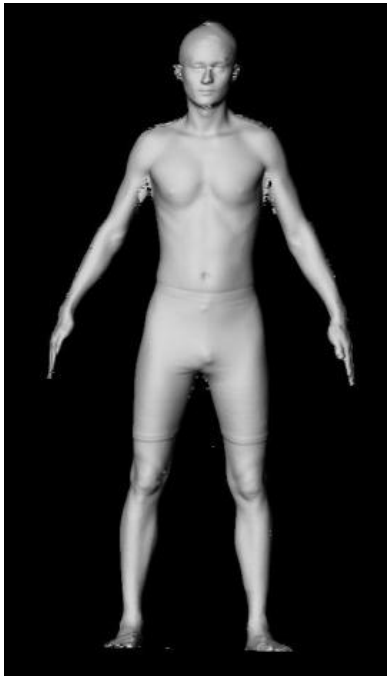


94 Body Measurements



3D Scans





How Many Soldiers?

N ≥13,000	Active Duty	Reserve	Guard	Aviators
Males	3510	TBD	2530	≥1000
Females	2900	TBD	2530	

- Power Sufficient for 5th/95th percentile estimates (ISO 15535)
  - Confidence level at 90%-95%
  - Precision at 1% of the mean

- Numbers sufficient to support:
  - Component/Sex subgroup analyses for design, sizing, tariffing
  - Minority subgroup analyses to ensure equity in design criteria
  - Statistical weighting of demographic subgroups when/if Army demographics shift in the future
  - Robust working databases for Total Army, Active, Guard, & Pilots

Anthropometric Tariffs

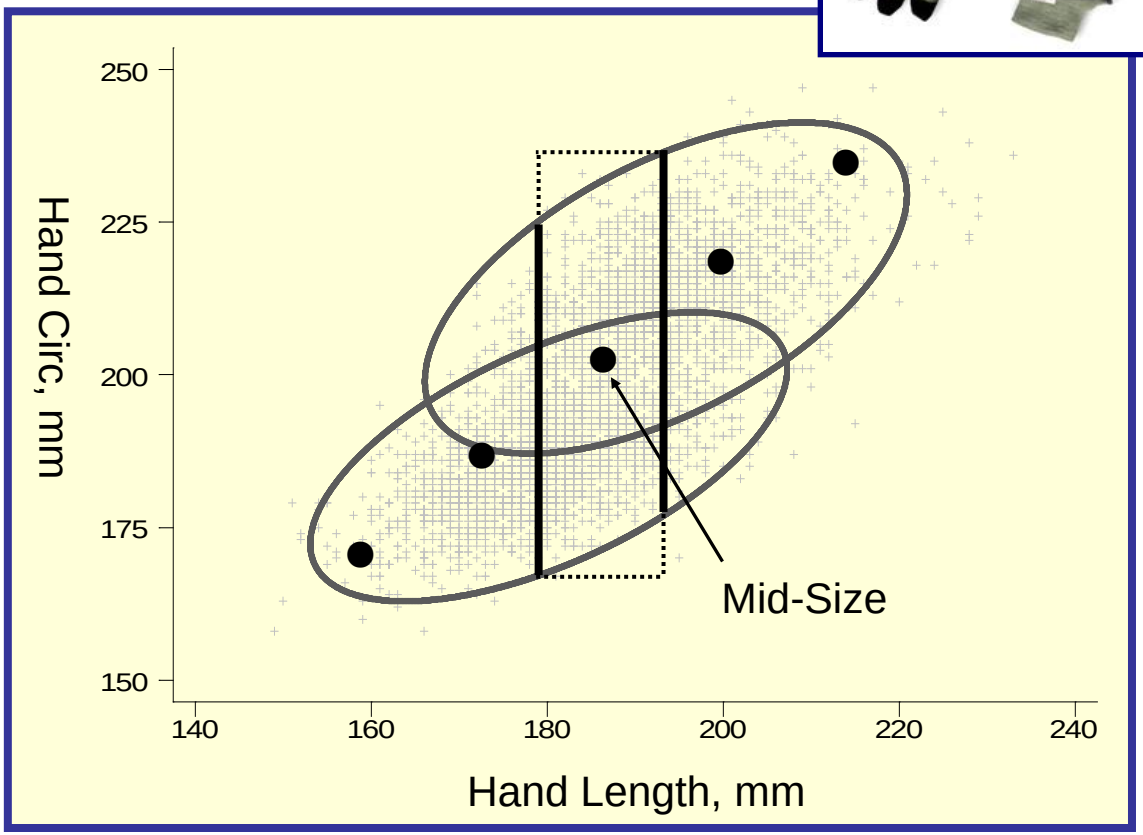
- Used for purchasing and stocking sized items
- Vary by item & sometimes by supplier when sizing systems are not standardized

Size	Frequency	Percent	Tariff
XS	4	0.39%	39
S	154	15.01%	1501
M	560	54.58%	5458
L	267	26.02%	2602
XL	41	4.00%	400
	1026	100.00%	10000

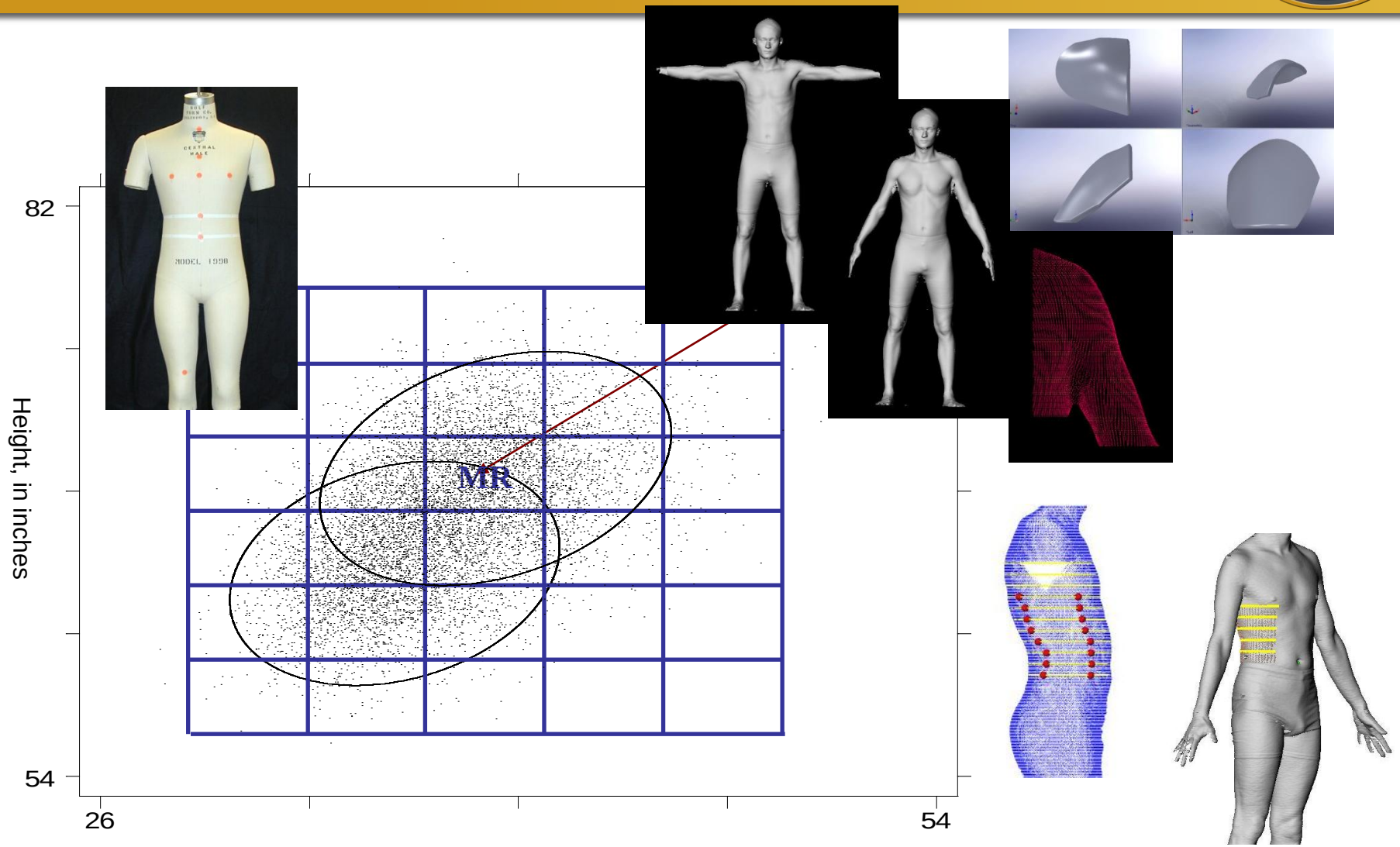
USMC Interceptor body armor: Brantley (2000) Natick TR-00/014

Anthropometric Sizing Systems

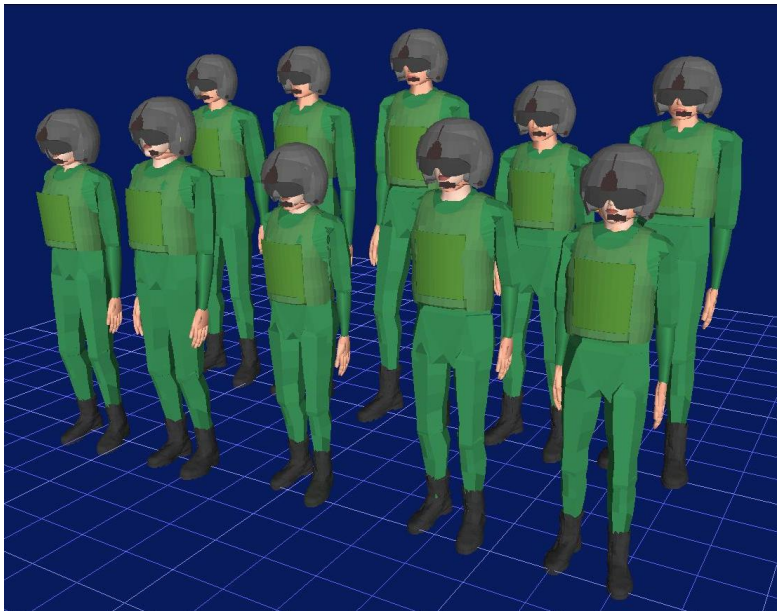
- Visualize accommodation envelope needed to capture a required % of users
- Statistically optimize location of size categories to minimize number of sizes
- Statistically optimize dimensions of patterns & forms to improve fit
- Validate size prediction charts

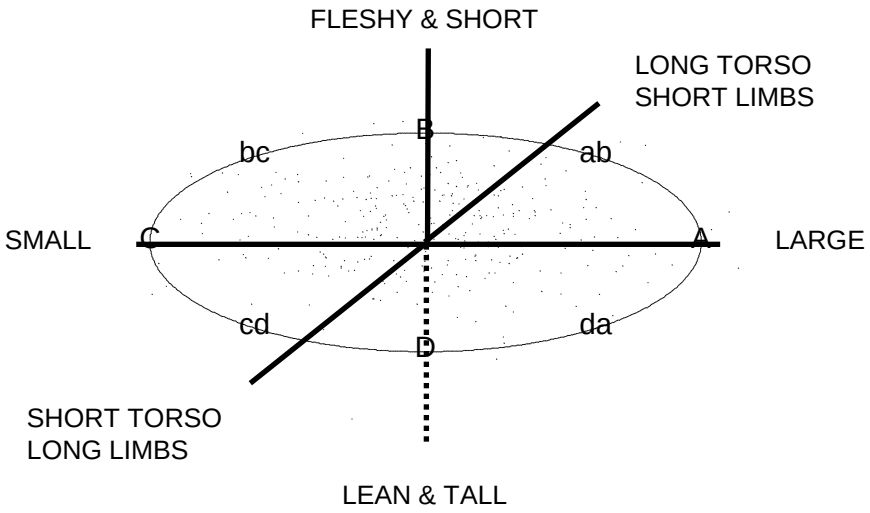


Anthropometric Sizing Models



Human Digital Models for Workstation & Vehicle Design





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